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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
A. C. TRUE, Director.

DESCRIPTION

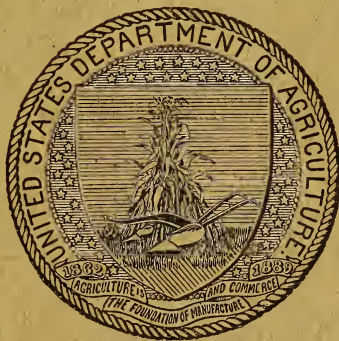
OF

EXHIBIT OF COLLEGES OF AGRICULTURE AND MECHANIC ARTS AND EXPERIMENT STATIONS,

LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904.

BY

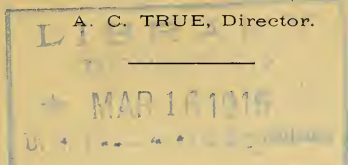
W. H. BEAL,
OFFICE OF EXPERIMENT STATIONS.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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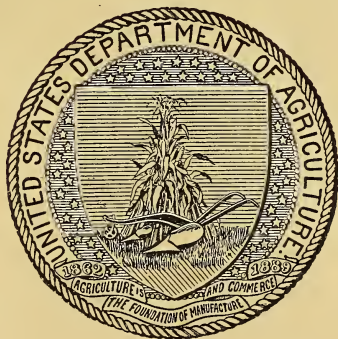
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., May 28, 1904.

SIR: I have the honor to transmit herewith, and to recommend for publication, a description of the exhibit of the agricultural colleges and experiment stations in the Palace of Education at the Louisiana Purchase Exposition, which is intended primarily for distribution to those attending the exposition.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction	7
Classification of exhibits	9
Exhibits of the Bureau of Education and the Office of Experiment Stations	9
Agricultural exhibits	9
Mechanic arts exhibits	10
Description of exhibits	10
Exhibit of the Bureau of Education	10
Exhibit of the Office of Experiment Stations	12
Agricultural exhibits	13
Agronomy, or plant production	13
Plant laboratory	13
Soils laboratory	14
Fertilizers	14
Field crops	14
Horticulture and forestry	15
Plant pathology	16
Entomology	16
Zootechny, or animal industry	17
Animal husbandry, investigation	17
Animal husbandry, instruction	19
Veterinary medicine	19
Agrotechny, or agricultural technology	19
Dairy laboratory	19
Sugar laboratory	19
Rural engineering	21
Rural economics	21
Inspection, or control work	21
Mechanic arts exhibits	22
Civil engineering	22
Mechanical engineering	22
Electrical engineering	22
Mining engineering	22
Technical chemistry	22
Architecture	23
Drawing and shop practice, including textiles and trades	23
Domestic science	23
Ceramics	23

ILLUSTRATION.

	Page.
PLATE I. Installation plan of the college and station exhibit	9

EXHIBIT OF COLLEGES OF AGRICULTURE AND MECHANIC ARTS AND EXPERIMENT STATIONS.

Louisiana Purchase Exposition, St. Louis, 1904.

By W. H. BEAL, *Office of Experiment Stations.*

INTRODUCTION.

The movement to prepare this exhibit was instituted at the 1901 meeting of the Association of American Agricultural Colleges and Experiment Stations, in Washington, and two committees were appointed to consider the matter, one representing agriculture and the other mechanic arts. At the Atlanta meeting of the association in October, 1902, these committees reported in favor of exhibits. The two committees were consolidated into one as an exposition committee, as follows: W. H. Jordan, chairman; A. C. True, secretary; W. T. Harris, H. J. Waters, W. M. Hays, W. E. Stone, T. F. Hunt, C. F. Curtiss, J. K. Patterson, and H. W. Tyler.

At the same meeting the executive committee of the association was charged with the duty of soliciting from Congress an appropriation for installing and maintaining the exhibit. Congress made such provision in the following terms:

For the selection, purchase, preparation, transportation, arrangement, installation, safe-keeping, exhibition, and return of such articles, animals, and materials belonging to or used by the agricultural colleges and experiment stations, hereinafter referred to, as the Government board created by act of Congress approved March third, nineteen hundred and one, as amended by the act of June twenty-eighth, nineteen hundred and two, may decide to exhibit as a part of the Government exhibit, to show the progress of education and experimentation in agriculture, mechanic arts, and animal husbandry at the Louisiana Purchase Exposition, to be held under authority of said act, of the colleges of agriculture and mechanic arts and agricultural experiment stations receiving the benefits of the acts of Congress of July second, eighteen hundred and sixty-two, March second, eighteen hundred and eighty-seven, and August thirtieth, eighteen hundred and ninety, one hundred thou-

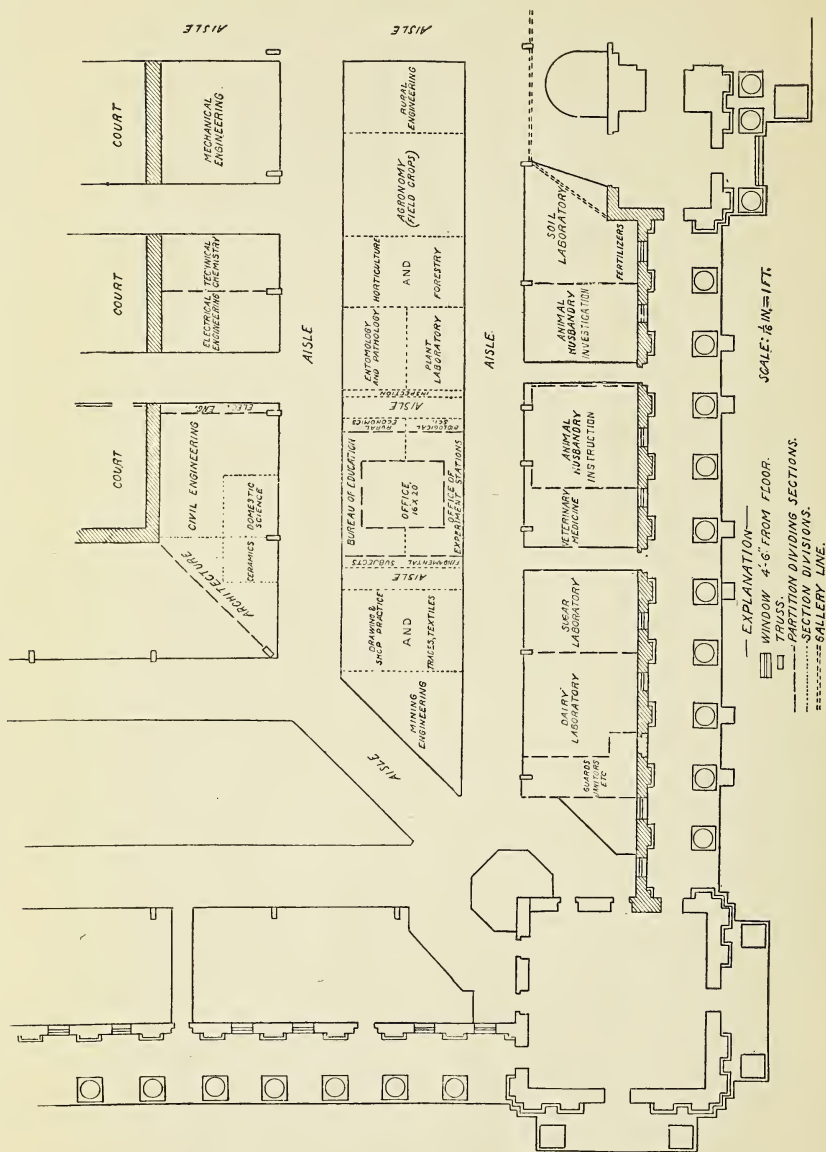
sand dollars, to be immediately available; which sum shall be expended for that purpose only, and upon the authority of said Government board: *Provided*, That the Louisiana Purchase Exposition Company, at its own cost and expense, shall furnish to said Government board adequate and suitable space in an appropriate building or buildings for the installation of said exhibit and its exhibition during the continuance of said exposition.

The Government board referred to in this act is made up as follows: Hon. J. H. Brigham, Assistant Secretary of Agriculture, chairman; Wm. H. Michael, chief clerk Department of State; Wallace H. Hills, chief clerk Treasury Department; John C. Scofield, chief clerk War Department; Cecil Clay, general agent Department of Justice; Jno. B. Brownlow, clerk, Post-Office Department; B. F. Peters, chief clerk Navy Department; Edward M. Dawson, chief clerk Department of the Interior; Carroll D. Wright, Commissioner of Labor, Department of Commerce and Labor; F. W. True, head curator National Museum, representing Smithsonian Institution and National Museum; W. de C. Ravenel, administrative assistant National Museum, representing Commission of Fish and Fisheries; G. W. W. Hanger, chief clerk Bureau of Labor; William C. Fox, chief clerk Bureau of the American Republics; William V. Cox, secretary, and Wm. M. Geddes, disbursing officer. This board entrusted the work of planning, collecting, and installing the exhibit to the committee of the association named above, the secretary of that committee, Dr. A. C. True, representing it in all official dealings with the board.

Mr. James L. Farmer, as chief special agent, has had the immediate charge of the execution of the plans of the committee.

It should be noted especially that the law provides for an exhibit of the progress of education and research in agriculture and the mechanic arts, and it has been the purpose of those charged with the duty of preparing the exhibit to make it illustrative of the distinctive work of the land-grant colleges, of which there are 65, and the experiment stations, of which there are 60, in the United States; that is, it represents those features of education and research which differentiate these institutions from other educational and scientific institutions. It was concluded that this purpose could best be accomplished by making the exhibit collective, i. e., assembling the contributions from the various institutions represented according to subjects rather than by institutions, due credit, of course, being given to all contributors to each group. The exhibit is therefore grouped according to the main divisions of agriculture and mechanic arts.

Since the work of the colleges of agriculture and mechanic arts and the experiment stations is in its broadest sense largely of an educational character, it was deemed appropriate that the exhibit should be installed in the Palace of Education. The exhibit occupies a total area of 16,000 square feet, or, deducting aisles, etc., an available space of



INSTALLATION PLAN, COLLEGE AND STATION EXHIBIT.

about 11,500 square feet, in the northwest section of this building (Pl. I).

The individual exhibits and the experts who have had charge of their collection and preparation are as follows:

CLASSIFICATION OF EXHIBITS.

EXHIBITS OF THE BUREAU OF EDUCATION AND THE OFFICE OF EXPERIMENT STATIONS.

- (1) Showing relations of the United States Government with education in agriculture and mechanic arts, under direction of Hon. W. T. Harris, Bureau of Education, Washington, D. C.
- (2) Relations of the United States with institutions for research in agriculture, under direction of Dr. A. C. True, Office of Experiment Stations, Washington, D. C.

AGRICULTURAL EXHIBITS.

I. AGRONOMY, OR PLANT PRODUCTION.

Soils, Prof. M. F. Miller, Ohio State University, Columbus, Ohio.
 Fertilizers, Director E. B. Voorhees, New Jersey Agricultural Experiment Stations, New Brunswick, N. J.
 Plant laboratory, Dr. W. H. Evans, Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.
 Field crops, Mr. J. I. Schulte, Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.
 Horticulture and forestry, Prof. S. B. Green, University of Minnesota, St. Anthony Park, Minn.
 Plant pathology, Mr. F. C. Stewart, New York State Agricultural Experiment Station, Geneva, N. Y.
 Economic entomology, Prof. Clarence P. Gillette, State Agricultural College of Colorado, Fort Collins, Colo.

II. ZOOTECHNY, OR ANIMAL INDUSTRY.

Animal husbandry (investigation), Director H. P. Armsby, Pennsylvania Agricultural Experiment Station, State College, Pa.
 Animal husbandry (instruction), Prof. Thos. F. Hunt, Cornell University, Ithaca, N. Y.
 Veterinary medicine, Prof. D. S. White, Ohio State University, Columbus, Ohio.

III. AGROTECHNY, OR AGRICULTURAL TECHNOLOGY.

Dairy laboratory, Prof. E. H. Farrington, University of Wisconsin, Madison, Wis.
 Sugar laboratory, Director W. C. Stubbs, Louisiana Agricultural Experiment Stations, Audubon Park, La.

IV. RURAL ENGINEERING, OR FARM MECHANICS.

This exhibit has been prepared under the direction of Prof. Elwood Mead, Office of Experiment Stations, U. S. Department of Agriculture, Washington, D. C.

V. RURAL ECONOMICS, OR FARM MANAGEMENT.

This exhibit has been prepared under the direction of Prof. Fred. W. Card, Rhode Island College of Agriculture and Mechanic Arts, Kingston, R. I.

Inspection, Director M. A. Scovell, Kentucky Agricultural Experiment Station, Lexington, Ky.

MECHANIC ARTS EXHIBITS.

Civil engineering, Prof. Anson Marston, Iowa State College of Agriculture and the Mechanic Arts, Ames, Iowa.

Mechanical engineering, Prof. W. F. M. Goss, Purdue University, Lafayette, Ind.

Electrical engineering, Prof. Bernard V. Swenson, University of Wisconsin, Madison, Wis.

Mining engineering, Prof. S. B. Christy, University of California, Berkeley, Cal.

Technical chemistry, Prof. W. H. Walker, Massachusetts Institute of Technology, Boston, Mass.

Architecture, Prof. W. H. Lawrence, Massachusetts Institute of Technology, Boston, Mass.

Drawing and shop practice (including textiles and trades), Prof. F. Paul Anderson, Agricultural and Mechanical College of Kentucky, Lexington, Ky.

Domestic science, Prof. Maude Gilchrist, Michigan State Agricultural College, Agricultural College, Mich.

Ceramics, Prof. Edward Orton, jr., Ohio State University, Columbus, Ohio.

DESCRIPTION OF EXHIBITS.

EXHIBIT OF THE BUREAU OF EDUCATION.

Centrally located in the collective exhibit of the agricultural colleges and experiment stations is a pavilion and office, around which are grouped the exhibits of the Bureau of Education and the Office of Experiment Stations which represent the United States Government in its relations with these colleges and stations.

The contribution of the Bureau of Education includes a set of the publications issued by that Bureau, a set of the catalogues of all of the colleges of agriculture and mechanic arts, various publications and illustrations furnished by those institutions, and statistical charts.

The publications of the Bureau are designed to show in a meas-

ure the work being done by it. The reports of the Commissioner which are published annually contain statistical and general information concerning educational systems and institutions in this and foreign countries, including the colleges of agriculture and mechanic arts endowed by the National Government. Historical sketches of some of these colleges are included in the histories of higher education in the several States, published by the Bureau as circulars of information.

The set of catalogues included in the exhibit shows in detail the nature and scope of the instruction offered by the several institutions, the material equipment available for instruction purposes, the number of professors and instructors employed and of students in attendance.

The act of Congress of July 2, 1862, under which the so-called "colleges of agriculture and mechanic arts" were established, provides that their leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. Under these liberal terms it is but natural that the scope of the instruction offered differs widely in the several States. In some of the States the instruction is limited very strictly to agriculture and engineering and to related subjects, while in others, especially in State universities endowed under this act, the courses are very diverse.

The extent of Federal aid to June 30, 1904, in land and in money granted to each State and Territory for colleges of agriculture and mechanic arts is shown in a large statistical chart entitled "Federal aid." It shows, first, the amount of invested funds derived from the sale of the lands granted to each State and Territory specifically for colleges of agriculture and mechanic arts, including the estimated value of unsold land, if any, as reported to the Bureau. Secondly, it shows the aggregate amount of appropriations received by each State and Territory to June 30, 1904, under the act of Congress of August 30, 1890, for the more complete endowment and support of the colleges established under the act of July 2, 1862. Thirdly, it shows the total amount, \$31,157,588, of Federal aid received from the two sources mentioned.

The land-grant college map included in this exhibit shows the location of each college of agriculture and mechanic arts, the amount of land received by each State for such institutions, and the total amount of land granted by the Federal Government for all other educational purposes. The total number of acres of public lands granted for educational purposes amounts to a little more than 86,000,000, of which amount 10,705,600 acres were granted specifically for colleges of agriculture and mechanic arts. The latter amount includes the grants made under the act of Congress of July 2, 1862, and several special grants made under special acts.

The chart entitled "Progress of Public and Private Higher Education in the United States in Twenty Years" shows in comparative form the progress made from 1882 to 1902, first, by the public (which list includes colleges of agriculture and mechanic arts) and, secondly, by the private institutions for higher education.

The smaller statistical charts on colleges of agriculture and mechanic arts show:

- (1) The growth in number of students from 1891 to 1903.
- (2) The increase in the value of the material equipment from 1870 to 1903.
- (3) The value of all property, including endowment funds owned in 1903.
- (4) The increase from 1865 to 1903 in the number of institutions, number of professors, and number of collegiate and graduate students.
- (5) The comparison of income from 1885 to 1903 with that of all other institutions for higher education.
- (6) The proportion of regular technical students pursuing certain degree courses.
- (7) The growth of libraries compared with that of all other institutions for higher education.
- (8) The attendance from 1890 to 1903 compared with that at all other institutions for higher education.

There are shown also nine volumes of examination questions and answers by students of a number of the colleges of agriculture and mechanic arts in English, French, German, Latin, mathematics, physics, chemistry, history, and economics, and in miscellaneous branches. These volumes are intended to give some idea of the nature of the work that is being done by the several institutions in some of the nontechnical or general studies usually included in the courses of study offered by these institutions.

EXHIBIT OF THE OFFICE OF EXPERIMENT STATIONS.

On the side of the pavilion occupied by the exhibit of the Office of Experiment Stations the central wall space is occupied by an electrical display machine showing prominent features in the origin, distribution, and work of agricultural experiment stations throughout the civilized world. The location of about 700 of these stations is shown on a map of the world hanging just across the aisle to the right of the display machine. The wall space on each side of this machine is occupied by charts showing the value of investigations made by these stations from the educational as well as the economic point of view.

Standing against the side walls of the pavilion are book cases containing bound sets of publications of the Office and of the experiment stations and about 200 text-books, manuals, and reference books written or edited by experiment station men. These books are based on the results of agricultural investigations in this country and abroad

and are doing very valuable service in reducing these results to pedagogic form. They constitute largely the science of agriculture as it is now coming to be recognized in this country.

In addition to their regular publications the stations also issue a large number of special publications—circulars, press bulletins, popular bulletins, spray calendars, etc. Specimens of these are shown in glass-covered cases. The agricultural experiment stations in the United States and the United States Department of Agriculture issue annually over 12,000,000 copies of bulletins, circulars, and other publications, the value of which in promoting better methods of farming is incalculable.

The wing frames placed above the glass-covered cases contain a large number of photographs illustrating some of the buildings, live stock, and other equipment of the experiment stations, as well as some of the more striking experiments conducted by them.

Surrounding the exhibits of the Bureau of Education and the Office of Experiment Stations are small exhibits of charts, drawings, photographs, etc., illustrating (1) FUNDAMENTAL SUBJECTS, mainly physical and mathematical, taught in the land-grant colleges as a basis for more advanced work; and (2) courses of study, apparatus, methods, and results of the work of the institutions represented, in BIOLOGICAL SCIENCES (botany, zoology, and physiology).

AGRICULTURAL EXHIBITS.

I. AGRONOMY, OR PLANT PRODUCTION.

The exhibits illustrating work in this subject include (1) plant laboratory, (2) soils laboratory, (3) fertilizers, (4) field crops (agronomy), (5) horticulture and forestry, (6) plant pathology, and (7) entomology.

PLANT LABORATORY.

The object of this exhibit is to show in operation a fairly well-equipped laboratory for instruction and research in the study of botany in its various phases, but especially as related to agriculture. The exhibit illustrates some of the methods followed at the institutions contributing to the exhibit and shows a number of appliances and pieces of apparatus which have been devised or modified by college or station men. It contains apparatus for preparing material and making microscopic studies of plant tissues; for studying transpiration and the humidity of the air, and the effect of gravity upon plant growth; for recording the rate of growth of plants; for studies of micro-organisms, including fermentation and fungus and other parasitic diseases of plants; of root growth, and of germination; for the examination and testing of seeds and for showing the effect of copper on foliage; besides illustrations of methods of making cultures of micro-

organisms; of selecting seeds by specific gravity; plant presses; seed cases for class-room use; and miscellaneous laboratory apparatus and accessories.

SOILS LABORATORY.

This exhibit shows a working laboratory in operation, equipped with special forms of apparatus contributed by a number of institutions for sampling soils, making mechanical and chemical analyses of soils, and studying their chemical and physical properties; samples of typical soils, student's laboratory outfit, cultures, etc., showing work on soil bacteria; specimens of students' notes. There are also photographs showing equipment and methods of work at a number of the agricultural colleges and experiment stations.

FERTILIZERS.

The fertilizer exhibit includes:

(1) Specimens of typical classes of soils showing the relative proportion of fertilizing constituents in each, and the relation of these to soil fertility and soil exhaustion.

(2) Samples of the principal commercial fertilizing materials, including crude and manufactured products, supplying nitrogen, phosphoric acid, and potash.

(3) A series of diagrams and photographs illustrating the relation of various systems of cropping, farm management, and fertilizing to soil fertility, and the relative availability of different kinds of fertilizers.

FIELD CROPS.

The exhibits in this section consist of material illustrating some of the more important experimental work with field crops carried on by the experiment stations of the United States, and showing in addition the different crops which are studied in our agricultural colleges, together with some of the methods employed to prepare the student for original research work and for practical farm management. The various classes of crops are represented and the exhibit of each individual crop is as extensive as circumstances allow. The object of the exhibits in this section is to show the purposes, methods, and results of investigations by the experiment stations together with the methods and scope of instruction given in this particular branch in the colleges of agriculture.

One of the principal features of the section is the plant-breeding work. Attention is called to the improvement of corn by an exhibit showing how by selection and crossing the percentage of protein and of oil may be increased in the crop, and how a variety may be made more productive or how its excellence may be maintained. The samples of wheat on exhibition illustrate Mendel's law in wheat breeding, the

improvement in yield by selection and crossing, and the methods of growing pedigreed wheat plants and keeping plant nursery records. The specimens of flax exhibited show how by these same methods the seed production of the crop may be improved and how the straw may be increased in length, thus rendering the crop of greater value for fiber. The samples of cotton shown point out the effect produced in the length and quality of the fiber by crossing varieties of different types such as the Sea Island, Upland, and Egyptian cottons. The possibilities of plant breeding are further exemplified in the cowpea exhibit, which calls attention to the extensive variation to which this plant is subject.

Independent of the plant-breeding work, samples of varieties of corn, wheat, oats, barley, and other cereals, and of cotton, cowpeas, soy beans, velvet beans, castor beans, sugar cane, tobacco, hemp, flax, and hops are presented for comparison. The yields in some cases show marked differences, pointing out at once the value of variety testing by the experiment stations and the importance of considering this matter in ordinary farm practice.

The section of field crops further illustrates and reports the results of growing field crops with different fertilizer treatment and under various systems of rotation. The significance of this line of experimental work is at once apparent when we consider that the intelligent use of fertilizers in connection with a proper crop rotation not only produces larger yields, but also maintains the fertility of the soil. The crops considered in this connection are wheat, oats, corn, potatoes, clover, and timothy.

An interesting object lesson is presented in a collection of root samples showing the root development of blue grass, corn, oats, clover, alfalfa, fife and macaroni wheats, and flax. The tobacco exhibit comprises a model illustrating the growing of tobacco under shade, a number of samples of shade-grown and open field-grown tobacco showing the effect of shade on the quality of the leaf, and a series of other samples representing the different types of tobacco which have entered into experimental work carried on in Connecticut.

The instruments and appliances used in college laboratory work with root crops, including sugar beets, mangels, ruta-bagas, carrots, and turnips, are shown and a general outline of the work is given.

The experimental work with field crops carried on at the Alaska, Hawaii, and Porto Rico stations is represented by a collection of specimens from these stations.

HORTICULTURE AND FORESTRY.

This exhibit consists of a collection of models, photographs, charts, etc., illustrating methods of instruction and research in these subjects at a number of the agricultural colleges and experiment stations, as

well as special forms of laboratory and greenhouse equipment and results of improvement of varieties and methods of culture. Improved horticultural and forestry implements and methods are also illustrated, and a collection of horticultural books, edited or written by college and station men, is shown.

Attention is called especially to (1) the date-palm exhibit, which represents the successful introduction of a new industry into the United States, showing the fine quality of dates now being grown in Arizona, as well as the peculiarities of date trees, blossoms, fruit, and seed; (2) the exhibit of methods of greenhouse laboratory work as shown by a portion of a greenhouse laboratory bench with lockers, illustrations of horticultural laboratory operations, text-book used, etc.; (3) the models of peach twigs, showing the relation of color to hardiness and date of blooming; (4) the models, photographs, and charts illustrating a successful method of winter forcing of asparagus; (5) the models illustrating fertilization of self-sterile grapes; (6) the models illustrating subirrigation for greenhouses, gardens, and lawns; (7) the display of implements and methods of pruning; (8) the exhibit of trunks of eucalyptus trees illustrating the successful introduction into this country of a group of valuable trees; (9) specimens showing the character of posts and timber produced in regions of deficient rainfall, and (10) the log scales, rules, calipers, and other implements used in forestry work and lumbering in different parts of the United States. Attention is also directed to the wing-frame cabinets containing mounted photographs, charts, drawings, etc., showing facilities and equipment for instruction and research in a large number of the land-grant colleges and experiment stations, horticultural and forestry methods, operations, and results.

PLANT PATHOLOGY.

This exhibit consists mainly of mounted specimens, specimens in solutions, photographs, drawings, etc., accompanied by explanatory labels, illustrating the more important diseases of crops and the nature of the injuries caused by them.

ENTOMOLOGY.

This exhibit consists of small contributions from a large number of institutions, and is intended to show something of the scope and quality of entomological work being carried on in the different agricultural colleges and experiment stations in the United States. Thirty-two cases filled with insects show many of the most destructive as well as some of the beneficial species, and give an idea of methods of mounting, labeling, and permanently preserving specimens in different stages of development. The pavilion and wall cases are filled with pieces of apparatus used in class room or laboratory or in field work in entomology. Professor Sanderson, of Texas, has illustrated his

method of note and record keeping, which is perhaps the most complete system in use anywhere. Professor Comstock, of Cornell, has placed on exhibition his block system of mounting a collection of insects. Professor Woodworth, of California, has put on exhibition a set of reference books in entomology to which his students have access. The injuries of boring insects are exhibited by Professor Popenoe, of Kansas. Professor Stedman, of Missouri, exhibits a special breeding cage. Director Thorne, of the Ohio Experiment Station, shows a new method of fighting the codling moth, etc.

A large number of photographs are displayed which show buildings, laboratories, class rooms, equipment for college and station work, methods of carrying on work, spraying machinery, insects and their injuries, diagrams, etc.

II. ZOOTECHNY, OR ANIMAL INDUSTRY.

ANIMAL HUSBANDRY, INVESTIGATION.

A complete showing of experiment-station work in this field is not attempted, and emphasis has been laid upon those methods and results tending to establish fundamental scientific principles rather than upon those yielding more immediately practical results, although the latter have been by no means excluded.

The exhibit may be grouped in a general way under three heads, viz, (1) feeding stuffs, (2) metabolism and the laws of nutrition, and (3) the practice of feeding.

Feeding stuffs.—In this group are shown several forms of apparatus used in the analysis of feeding stuffs, especially for the determination of protein and ether extract (crude fat); an apparatus for drying in vacuo; appliances for making digestion experiments with animals; a complete collection of products and by-products of corn and cotton seed; a collection of pure vegetable proteids arranged according to the classes of feeding stuffs from which they were derived, with descriptive data; specimens and charts showing results of investigations of pentosans of hay, cornstalks, etc.; drawings of microscopic studies of the structure of feeding stuffs as a basis for the detection of adulteration. Large wall charts show the average composition of a few of the more important feeding stuffs, smaller charts show the average results of digestion experiments with American feeding stuffs, the feeding value of corn silage and corn by-products, and similar data.

Metabolism and the laws of nutrition.—A working model, one-fifth the actual size, of the respiration calorimeter constructed by the Pennsylvania Station cooperating with the Bureau of Animal Industry of the U. S. Department of Agriculture for experiments with large farm animals is shown. The purpose of this apparatus is to determine, in addition to those facts which can be ascertained by an experi-

ment with the digestion apparatus, the amount of gaseous material (carbon dioxide, water, methane) given off by the animal and also the amount of energy liberated by it in the form of heat. The apparatus is modeled after one devised for experiments with man by W. O. Atwater and E. B. Rosa, photographs of which are shown.

By means of this apparatus a complete account is kept of the outgo of both matter and energy from the animal. An analysis of the food and a determination of its heat of combustion supplies similar data as to the income of the animal and thus a nearly complete debit and credit account with the animal may be kept, showing exactly how much of its food is utilized and for what purpose.

The results of a series of four experiments with this apparatus upon timothy hay are illustrated in the exhibit, the quantities of energy involved being represented by blocks of anthracite coal sufficient to produce equivalent amounts of heat when completely burned. The exhibit shows first, the total energy of the food; second, the amount lost in the various excreta; third, the amount of food energy supplied by oxidation of the tissues of the body in two cases, or, in the other two, the part of the energy of the food which was stored as increase of tissue. Charts showing graphically some of the results of these experiments are also shown.

There is also an exhibit of the total energy of 10 kilograms of timothy hay and of corn meal, respectively, and the portion of this lost in the excreta, consumed by the processes of digestion and assimilation, and remaining available for the general purposes of the organism.

In the exhibit of the results of experiments upon the sources of milk fat there is shown in glass cylinders the amount of fat digested from the food of each of three cows the fat that may possibly have been formed from the protein broken down in the body, the fat actually found in the milk and the fat which must necessarily have been produced from the carbohydrates of the food. The same results are shown graphically in a series of seven charts contained in the wall cabinets.

The practice of feeding.—The influence of shelter and of concentrated feeds rich in nitrogen on growth of beef cattle, the comparative value of different kinds of roughage, the influence of food on the make-up of the carcass, are shown by means of models and charts.

The results of experiments on soiling crops with views of modern dairy buildings and equipment are shown by means of transparencies.

There are also shown trap nests used in breeding experiments with poultry and illustrations of methods of preserving eggs in water glass.

Practical and theoretical methods of feeding horses are illustrated by sample rations and chart data.

ANIMAL HUSBANDRY, INSTRUCTION.

This exhibit illustrates a class room for instruction in this subject, including a mount of Shamrock the prize-winning steer of the Chicago livestock show of 1902, the most improved implements, apparatus, and accessories required for instruction, wall charts showing enlarged specimens of students' score cards, and a series of mounted photographs illustrating methods of instruction in this subject at a large number of agricultural colleges.

VETERINARY MEDICINE.

This exhibit illustrates the methods and appliances used in instruction and research in this subject, with specimens of animal diseases.

III. AGROTECHNY, OR AGRICULTURAL TECHNOLOGY.

DAIRY LABORATORY.

The attempt is made in this exhibit to illustrate, by means of objects, apparatus, charts, large photographs, and descriptive matter, the dairy instruction given in the American agricultural colleges, and some of the results of dairy investigations made in the experiment stations. It shows the quality of dairy products made by different methods and under different conditions, and the methods, machinery, and appliances used in testing and handling milk and its products.

Attention is called especially to the exhibits illustrating the composition of dairy products of various kinds, the machinery, appliances, and methods used in the testing of milk, butter, and cheese; the cultures of the various bacteria which bring about changes in milk and dairy products; the methods of obtaining clean milk and of making and preserving butter and cheese; the methods of handling and skimming milk; the conditions affecting milk production; and the dairy buildings and equipment of the agricultural colleges and experiment stations of the United States.

SUGAR LABORATORY.

Sugar cane and its products.—This exhibit can be divided into two principal groups. The first consists of a large collection of sugar-cane varieties, grades of commercial sugars, sirups and molasses, fertilizers, and other products relating to the agricultural and technical sides of the sugar-cane industry. The second shows the different apparatus and appliances employed. A number of photographs, charts, and diagrams are also exhibited.

Sixty-four of the different natural varieties of sugar cane produced at Audubon Park from canes obtained from the West Indies, Mexico, Hawaii, Java, India, and other parts of the world are shown. Attention is especially called to the Louisiana Purple and the Striped varieties, which are the chief canes cultivated in Louisiana. Of historical interest is the Creole variety, which was the first cane introduced into

Louisiana, having been brought in by the Jesuits in 1757. The sugar cane is an exotic in Louisiana, and does not flower nor produce seed. In the tropical countries, however, seed is produced, and a specimen of this is shown. A great deal of attention has been paid of late to the propagation of new varieties of cane from sugar-cane seed, and many of these seedling varieties have been studied. Nineteen specimens of these are shown in jars. Of particular importance in Louisiana are the seedlings D. 74 and D. 95 (Demerara Nos. 74 and 95). These canes, particularly the D. 74, give a larger tonnage than the home varieties, and also a much greater sugar content.

In the study of the sugar cane at Audubon Park, very exhaustive experiments upon cultivation and fertilization have been conducted. Specimens of the various fertilizers employed are shown. The field results of fertilizer and cultivation experiments are presented by charts.

The field work upon sugar cane at Audubon Park is always supplemented by practical experiments at the station sugarhouse, which is fully equipped with all the modern appliances for the manufacture of sugar. Products from this sugarhouse are presented, illustrating all the stages in the manufacture of sugar, passing from the raw juice through the process of clarification, evaporation, and crystallization to the final product, or what is known as first sugar. The molasses from this sugar, which is separated by centrifugals, is then further worked up into second and third sugars. Details of the sugarhouse work are illustrated by charts.

Samples of the different grades of commercial sugars and of the various grades of sirups and molasses which are manufactured upon the plantations of Louisiana, are also shown, as well as specimens of the different refined sugars manufactured from the raw plantation products.

Considerable attention is being paid at present to the economic utilization of the various by-products of the sugarhouse, such as molasses and bagasse. A large amount of molasses is being fed in Louisiana to farm animals, either in the liquid state or mixed with absorptive ingredients, such as hay, bagasse, rice, bran, corn, oats, etc. The manufacture of these mixed feeds is an industry of growing importance, and a number of the most common commercial mixtures are shown. Large quantities of molasses are also fermented and worked up into alcohol and different grades of distilled products. Samples of the latter are exhibited. Molasses after the alcoholic fermentation is also made up into vinegar, a sample of which is shown in the exhibit. The mill bagasse, or expressed cane, is at present utilized almost entirely as a fuel under the sugarhouse boilers. Experiments have been made toward a better utilization of bagasse for the manufacture of paper. Samples of bagasse, pulp, and grades of paper are shown. Some of the papers, particularly those made from the pithy

part of the bagasse, possess parchment-like properties that render them exceedingly valuable.

Specimens of fiber board manufactured from bagasse are also shown. This fiber board has exceedingly valuable properties which render it useful for the manufacture of powder casks, veneerings, panels, and a number of other materials.

In connection with the chemistry of the sugar cane and sugars, there is shown a laboratory exhibit, containing a collection of the common sugars and carbohydrates from various sources, together with various products and derivatives of the same, and of laboratory appliances and apparatus used in sugar house control and more technical studies in sugar chemistry.

A determination of the melting point of the hydrazones and osazones is of great value in the study and identification of the different sugars, and apparatus for this purpose is also shown in the exhibit.

Sorghum and its products.—This group contains samples of sorghum canes and sorghum sirup, sugar, molasses, and masse cuite, and illustrates the possibilities of this crop for sugar production.

Maple sugar.—This group illustrates methods and appliances used in collecting sap and preparing maple sugar and sirup, as well as the results of investigations on the flow of sap carried on by the Vermont station for a number of years.

IV. RURAL ENGINEERING.

This exhibit consists of apparatus, models, charts, photographs, etc., illustrating methods of irrigation and drainage (including models of a plant house and farm plats used for investigations in these subjects), farm buildings and implements (including homemade windmills, silos, plows, etc.), the layout of farms (students' plans, etc.), courses of instruction, etc., at the land-grant colleges and experiment stations.

V. RURAL ECONOMICS.

This exhibit consists almost exclusively of charts showing courses of instruction in the land-grant colleges and statistics relating to different systems of farm management.

INSPECTION, OR CONTROL WORK.

This exhibit illustrates the work of the agricultural colleges and experiment stations in the inspection of fertilizers, feeding stuffs, etc. About thirty States provide by law for inspection of some kind, and in the large majority of cases the work is intrusted to the agricultural experiment stations of the various States and Territories.

MECHANIC ARTS EXHIBIT.**CIVIL ENGINEERING.**

Includes publications, photographs, drawings, implements and apparatus, models, and specimens of students' work, illustrating the equipment, courses of instruction, and some results of work in this subject at the land-grant colleges, especially the examination of building materials.

MECHANICAL ENGINEERING.

Includes publications, photographs, drawings, machinery and apparatus, models, and specimens of students' work, illustrating the equipment and results of work in this subject at the land-grant colleges.

ELECTRICAL ENGINEERING.

Includes illustrations of equipment and facilities for work in this subject in some of the land-grant colleges.

MINING ENGINEERING.

This exhibit consists largely of a series of transparencies illustrating the equipment and some results of the work of the land-grant colleges in this subject.

TECHNICAL CHEMISTRY.

This exhibit consists of contributions from Cornell University, showing by means of a very complete series of photographs, the facilities at the disposal of the student for carrying on chemical work, by means of charts and diagrams, the courses of study pursued, and by means of specimens, the results of the work; from Ohio State University, consisting of photographs, showing the plant and some diagrams illustrating the course of study, the subject of quantitative analysis being shown in some detail by means of samples of materials analyzed and an outline of the procedure employed; from Pennsylvania State College, consisting in an elaborate display of the products of students' work in organic research, technical inorganic preparation, and organic preparation, the method of teaching quantitative analysis being shown by an exhibit of the materials used in the work; from Massachusetts Institute of Technology, which shows the object sought after, the method employed, and the results obtained in teaching the various subjects of applied chemistry.

There are shown in detail all the branches of technical chemistry, including chemical engineering. A large number of photographs and drawings further illustrate the method of carrying on the work. The illustrative material used in a number of lectures (taken as types) are displayed.

ARCHITECTURE.

This exhibit shows by means of photographs, lecture notes, textbooks, and students' work the methods of teaching and some of the results obtained in the three architectural options, viz, general architecture, architectural engineering, and landscape architecture.

DRAWING AND SHOP PRACTICE, INCLUDING TEXTILES AND TRADES.

Includes illustrations of equipment and facilities for training in these lines at a number of the land-grant colleges, with methods and specimens of work.

DOMESTIC SCIENCE.

In this exhibit the equipment of the land-grant colleges for instruction in this subject, some results of the work, and the methods and courses of instruction used are shown by means of photographs, charts, and specimens contributed by nine of these colleges.

CERAMICS.

Contains photographs, transparencies, etc., illustrating facilities for instruction in this subject at some of the land-grant colleges.

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